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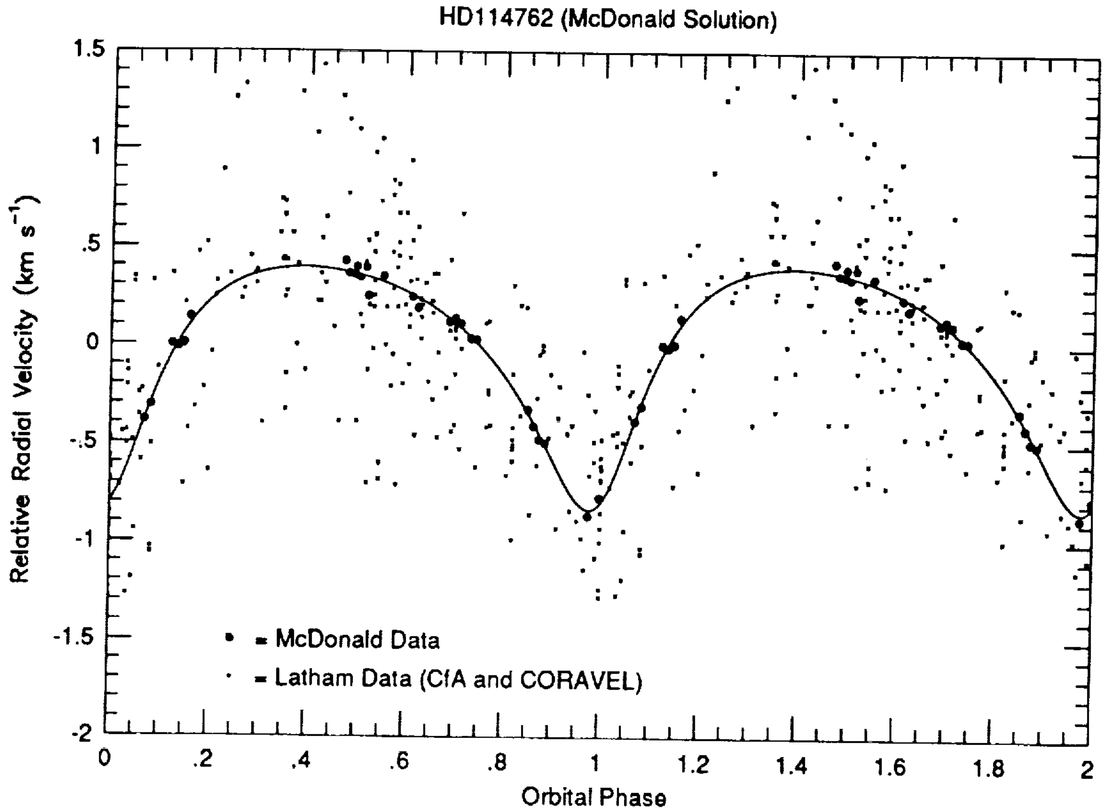
The Companion Object to HD114762 . . . . W. D. Cochran

The most interesting results obtained so far in the McDonald Observatory Planetary search concern the star HD114762. Lower precision radial velocity variation results by David Latham of Harvard indicated that this star might have a companion object, with an orbital period of about 84 days. We have obtained 28 independent radial velocity measurements on this star, and we are now able to derive our own orbit solution. We confirm the existence of a companion object in an orbit with a semimajor axis about 0.4 au. Our new orbit solution is shown in the figure below. The solid line is the radial velocity curve from our orbit solution. The large dots are our radial velocity observations, and the small markers are the discovery observations of Latham, phased to our orbit solution. The mass function indicates that the companion has $M \sin i = 0.011\ M_{\odot}$. If we are viewing the system nearly equator-on, then the companion object could easily be a planet. A year ago we tested for the case of an exactly equator-on orientation by searching unsuccessfully for transits of the secondary object across the disk of the star (Robinson *et al.* 1990, *A. J.* **99** 672-674). We have since taken our observed spectra which were used to calculate the radial velocity variations, and we have analyzed the stellar spectral line profile shapes. In the profile of a stellar photospheric absorption line, there are two dominant line broadening processes. These are macroturbulence, which results from Doppler shifts due to photospheric convection patterns, and rotational broadening due to the component of the stellar rotation along the line of sight. For a given star, the macroturbulence will be independent of the viewing geometry, while the rotational broadening will depend on the sine of the inclination angle. When the stellar photospheric line profiles are analyzed in the Fourier domain, the two types of broadening can be separated. We have modeled the photospheric line profiles in HD114762, and have concluded that the best fit is with a macroturbulent broadening of 4.7 km s^{-1} (which is well within the range of what is to be expected for this type of star), and a rotational broadening of 0.0 km s^{-1}. Our upper limit on the projected rotational velocity $V \sin i$ is 1.0 km s^{-1}. This very low value of the projected rotational velocity is quite significant. There is a very tight observed relationship between stellar mass and true equatorial rotational velocity. An F9V star such as HD114762 should have a true rotational velocity of about 13 km s^{-1}. Therefore, we are able to place an upper limit on $\sin i$, the sine of the stellar inclination angle, of 0.08. However, in our solar system the solar equator is inclined by 7.25 degrees to the ecliptic. If we allow a similar misalignment between the stellar rotational angular momentum vector and the orbital angular momentum of the companion object in HD114762, then our constraint becomes $\sin i < 0.20$ for the companion object. Since we had determined from our high precision radial velocity measurements that the companion object had $M \sin i = 11$ Jupiter masses, we can now determine that the companion object mass is at least 55 Jupiter masses, or $0.055\ M_{\odot}$. This would mean that the companion is not a planet, but instead is a brown dwarf or a low mass star in a system viewed nearly pole-on. We have determined that this system is a "false alarm" for planet detection!



Radial velocity curve for HD114762. The McDonald Data are shown as the large dots, and the original discovery data of Latham *et al.* (1989) are show as the small markers. The solid line is the radial velocity curve derived from the McDonald data orbital solution.